Section 5

MAINTENANCE AND SERVICE TESTS

This section contains preventive maintenance information, performance verification tests, and battery maintenance information for the 1.5 series infusion systems and the 1.6 series infusion systems.

5.1 PREVENTIVE MAINTENANCE

A preventive maintenance program promotes longevity and trouble-free infusion system operation. Such a program should include inspection, cleaning, and sanitizing. As a minimum requirement, perform preventive maintenance on the infusion system after each use. Establish a regular preventive maintenance schedule during use. Always perform preventive maintenance as part of any scheduled service or after any repair.

In addition, clean the infusion system and run the Performance Verification Test (PVT) described in *Section 5.2 (1.5 series)* or *Section 5.3 (1.6 series)* as part of any scheduled service or after any repair procedure.

5.1.1 INSPECTING THE INFUSION SYSTEM

Inspect the infusion system periodically for signs of defects such as worn accessories, broken instrument connections, or damaged cables. In addition, inspect the infusion system after repair or during cleaning. Replace any damaged or defective external parts.

Inspect the following for missing or damaged parts and for cosmetic defects:

- ❑ All cords
- ❑ Case
- ❑ Pole clamp and pad
- ❑ All switches
- ❑ Accessory jacks
- ❑ Faceplate
- ❑ Pressure pads (feet)
- ❑ Velcro® strap
- ❑ Minipole and clutch
- ❑ Door assembly (open and unlatch door; check valve pins and air sensor behind door. Valve pins should move freely in the guide holes. Clean as necessary)
- ❑ Flow detector (1.6 series, as applicable)
- ❑ Junction box (1.6 series, as applicable)

5.1.2

CLEANING THE INFUSION SYSTEM

The following procedures are designed to maintain the infusion system, sustain system longevity, and promote trouble-free operation.

Follow hospital protocol for establishing the infusion system cleaning schedule.

WARNING

DISCONNECT THE INFUSION SYSTEM FROM AC (MAINS) POWER PRIOR TO CLEANING THE INSTRUMENT. FAILURE TO COMPLY WITH THIS WARNING COULD RESULT IN ELECTRICAL SHOCK.

CAUTION: Do not immerse the infusion system in liquids. Immersion could damage the instrument. Do not allow liquids to enter the infusion system electronics compartment.

CAUTION: Certain cleaning and sanitizing compounds may slowly degrade components made from some plastic materials. Using abrasive cleaners or cleaning solutions not recommended by Abbott Laboratories may result in product damage and, potentially, void the product warranty. Do not use compounds containing combinations of isopropyl alcohol and dimethyl benzyl ammonium chloride.

Clean the exposed surfaces of the infusion system with a soft, lint-free cloth dampened with one of the cleaning solutions listed in *Table 5-1, Cleaning Solutions*, or a mild solution of soapy water. Remove soap residue with clear water. Do not use solvents that are harmful to plastic, such as isopropyl alcohol or acetone. Do not use abrasive cleaners.

CAUTION: Do not spray cleaning solutions toward any openings in the infusion system.

Table 5-1. Cleaning Solutions

Cleaning Solution	Manufacturer	Preparation
Vesphene® IIse	Calgon Vestal Laboratories	Per manufacturer's recommendation
Manu-Klenz®	Calgon Vestal Laboratories	Per manufacturer's recommendation
Formula C™	Diversey Corporation	Per manufacturer's recommendation
Super Edisonite®	S. M. Edison Chemical Co.	Per manufacturer's recommendation
Household bleach	Various	Per hospital procedures; do not exceed one part bleach in four parts water
LifeCare® Germicidal Towelette	Manufactured for Abbott Laboratories	Per manufacturer's recommendation; use undiluted

Clean the cassette door with a soft, lint-free cloth dampened with one of the cleaning agents listed in *Table 5-1, Cleaning Solutions*, or a mild solution of soapy water. Use a small non-abrasive brush to aid in cleaning the infusion system housing and subsystem chassis components. To thoroughly clean the cassette receptacle, disengage the cassette door from the door latch by pressing the door release tab (*see Figure 5-1, Mechanical Elements Behind Cassette Door*). Use cotton swabs to clean the pins. No other routine maintenance is necessary, except as required by hospital policy.

Clean the flow detector with a soft cloth dampened with soapy water. Carefully clean the sensor windows with a cotton swab dipped in soapy water. After cleaning, thoroughly dry the windows.

CAUTION: To avoid infusion system damage, cleaning solutions should be used only as directed in *Table 5-1*. The disinfecting properties of cleaning solutions vary; consult the manufacturer for specific information.

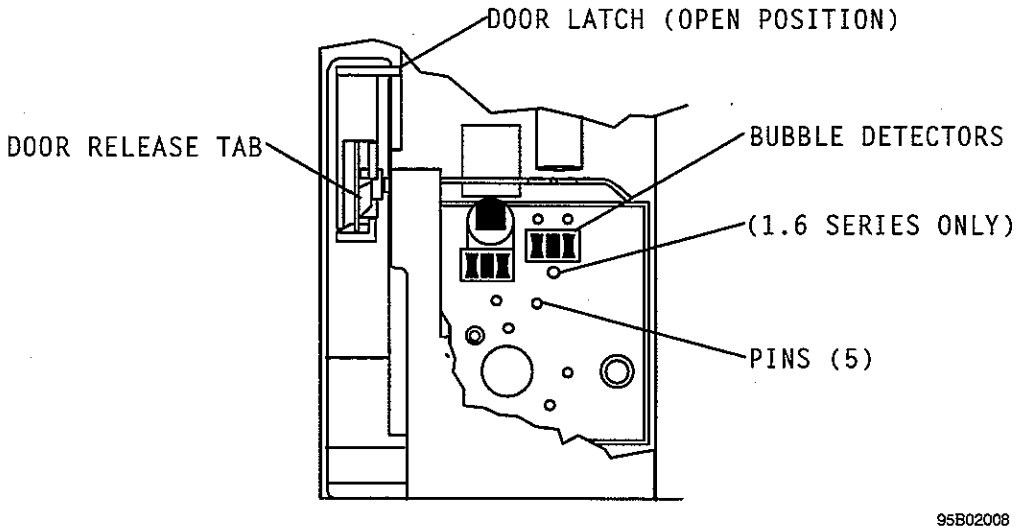


Figure 5-1. Mechanical Elements Behind Cassette Door

5.1.3
SANITIZING THE INFUSION SYSTEM

Sanitize the external surfaces of the infusion system using a cleaning solution listed in *Table 5-1, Cleaning Solutions*.

Note: Not all cleaning solutions are sanitizers. Check product labeling.

CAUTION: Do not sterilize by heat, steam, ETO, or radiation, as these methods cause the infusion system to malfunction.

5.2
PERFORMANCE VERIFICATION TEST (1.5 SERIES)

As a part of a preventive maintenance schedule, it is recommended that the PVT be conducted periodically per hospital procedures for compliance to accreditation requirements.

Note: To document test results, PVT data forms for 1.5 series infusion systems are provided in *Section 5.4*.

The PVT consists of the tests described in the following sections. These tests are used for diagnostic purposes during the troubleshooting of a malfunctioning infusion system, and for verification of the overall performance of an infusion system as part of a preventive maintenance schedule. In addition, the PVT should be used for performance verification before an infusion system is placed back in service after repair.

Note: It is essential that the PVT be performed exactly as described in this manual to assure effective and reliable product evaluation information.

Section 5.2 consists of the PVT for 1.5 series infusion systems. For performance testing of 1.6 series infusion systems, use the PVT in *Section 5.3*.

5.2.1
EQUIPMENT AND MATERIALS REQUIRED

The equipment and materials or equivalents required to perform the PVT for 1.5 series infusion systems follow:

- ❑ Safety analyzer, Dynatech Nevada® Model 231D
- ❑ Digital pressure meter (DPM), 0 to 50 psig (0 to 345 kPa), Bio-Tek® DPM II
- ❑ 21-gauge needle, List No. 4492
- ❑ Nurse-call test cable or equivalent 1/4 inch phone jack to banana plug, P/N 561-88416-001
- ❑ Three-way stopcock, List No. 3233
- ❑ 470 ohm/100 microfarad resistor/capacitor network, P/N 561-88419-001
- ❑ Digital multimeter (DMM), Fluke® Model 77
- ❑ Two containers of sterile water, List No. 7973-08, or tap water
- ❑ IV sets, List Nos. 6426-02 and 3047-01
- ❑ 20 cc plastic syringe, volume limited at 20 cc
- ❑ 25 mL cylinder graduate (0.2 graduations)
- ❑ No. 2 Phillips screwdriver
- ❑ Hex nutdriver set
- ❑ Stopwatch
- ❑ Starter, P/N 595-81671-001
- ❑ Special cassette, P/N 595-81670-001, with proximal bubble sensor tips removed from cassette, and marked EMPTY on the cassette

- ❑ Special cassette, P/N 595-81670-001, with distal bubble sensor tips removed, and marked AIR on the cassette
- ❑ Bubble sensor location fixture, P/N 561-81402-001*
- ❑ Bubble sensor location calibration block (calibration block), P/N 561-81402-006*

***Note:** The bubble sensor location fixture and calibration block are required only when performing the bubble sensor location test.

5.2.2
INSPECTION

Before starting the tests, thoroughly inspect the infusion system as detailed in *Section 5.1.1, Inspecting the Infusion System.*

5.2.3
START-UP TEST

WARNING

A PATIENT SHOULD NEVER BE CONNECTED TO THE INFUSION SYSTEM DURING TESTING.

The following tests are conducted with the infusion system in the MACRO SECONDARY MODE (dual channel, single dose). When the infusion system is in this mode, the LCD screen displays: LIFECARE 5000 DUAL CHANNEL. Prior to starting the PVT, note the configuration of the DIP switches and place the infusion system in the MACRO SECONDARY MODE as necessary. Refer to *Section 1.9, Setting the Delivery Mode*, for information on DIP switch settings for the desired mode. See also *Figure 1-1, DIP Switch Settings for Each Delivery Mode.* At the conclusion of the PVT, reset DIP switches to the previous settings.

Note: For all testing, the vertical distance from the top of the fluid in the flexible container to midline of the cassette must be 18 ± 6 inches (46 ± 15 cm).

To perform the start-up test, proceed as follows:

1. Insert the primed IV set, with 21-gauge needle attached to the distal line end, into the door. Close the door and verify that the red battery power symbol illuminates.
2. Connect the infusion system to an AC (mains) outlet and verify that the green AC (mains) power symbol illuminates.

   Note: Complete the remainder of the PVT with the infusion system connected to AC (mains) power, except as specified.

3. To verify that all touchswitches emit one short tone or flutter, press each touchswitch in sequence, as follows:

   [START]
   [RESET]
   [REVIEW/CHANGE]

[SILENCE/NO]

Down Arrow

Up Arrow

[YES/ENTER]

[CLEAR]

4. Press all touchswitches again except [START] and [CLEAR] in same sequence as described in Step 3; verify that no tones sound. Press [CLEAR] and listen for flutter.
5. Press all touchswitches again as described in Step 3; listen for tone or flutter.
6. Optional. Open and reclose door. When the SELF TEST:OK prompt appears for three seconds, press the [REVIEW] touchswitch to display the software version. Press [REVIEW] again to view the alarm history.

Note: Throughout this manual, a touchswitch, such as [REVIEW/CHANGE], may be referred to by the name that most closely describes its function in a particular procedure. For example, the [REVIEW/CHANGE] touchswitch is referred to as the [REVIEW] touchswitch in Step 6.

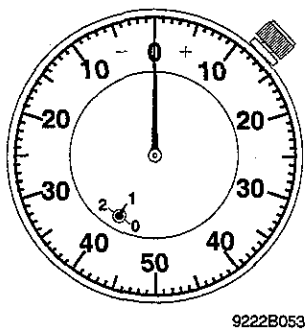
5.2.4
BUBBLE SENSOR LOCATION TEST

To perform the bubble sensor location test, refer to *Figure 5-2, Gauge Dial Indicator.* Standardize the gauge of the bubble sensor location fixture, as follows:

1. Place calibration block (boss end) of bubble sensor location fixture over each contact pin, holding the block flush to the base of fixture.
2. Check gauge dial indicators for 0 reading on outer scale and 1 inner revolution indicator. Adjust bezel to 0 as necessary by loosening bezel clamp. Retighten after adjustment is made.

After standardizing the fixture, perform the bubble sensor location test, as follows:

1. Insert bubble sensor location fixture in cassette door and close door.
2. Verify that both dial indicators read 1 revolution ± 0.010.
3. Open cassette door and remove fixture.



9222B053

Figure 5-2. Gauge Dial Indicator

5.2.5
NURSE-CALL TEST

Note: The following test may be bypassed if the nurse-call function is not used.

To perform the nurse-call test, attach the nurse-call cable, then proceed as follows:

1. Set primary delivery rate to 400 mL/hr and primary dose limit to 1 mL.
2. Connect DMM to nurse-call cable.
3. Press [START] and verify pumping action.
4. After DOSE END and KVO appear on the LCD screen, observe short circuit on DMM (approximately 1 ohm on 0 to 100 ohms scale).

5.2.6
EMPTY CONTAINER TEST

To perform the empty container test, refer to *Figure 5-3, Dry Cassette*, then proceed as follows:

1. Insert the special cassette marked EMPTY, with the proximal bubble sensor bulb tips removed (*see Figure 5-4, Infusion System Cassettes with Bubble Sensor Tips Removed*).
2. Attach starter and close door.
3. Set RATE to 400 mL/hr and press [ENTER].
4. Set DOSE LIMIT to 10 mL and press [ENTER].
5. Press [NO] in response to SET SECONDARY.
6. Press [START] and verify that pumping occurs. Within three pumping cycles, verify that one of the following messages appears on the LCD screen: STOPPED AIR IN PROXIMAL LINE PRESS RESET or STOPPED CHECK SET REPRIME SET.
7. Open door and remove cassette.

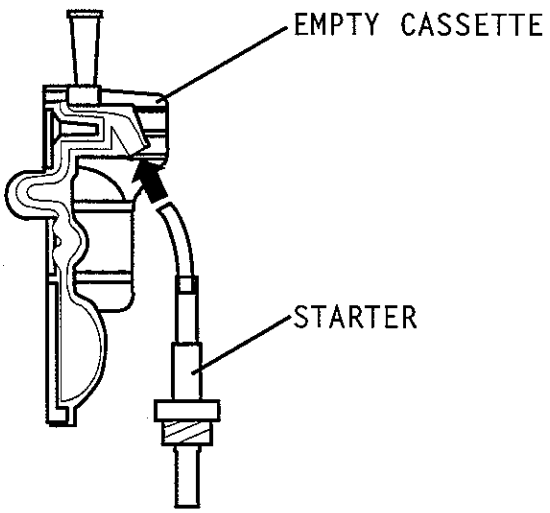


Figure 5-3. Dry Cassette

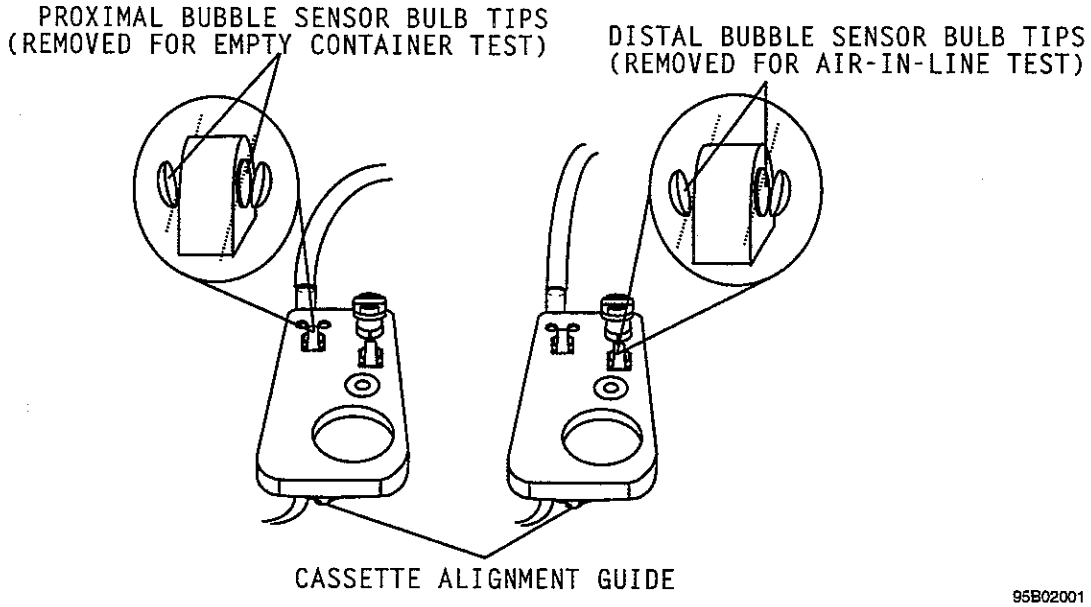


Figure 5-4. Infusion System Cassettes with Bubble Sensor Tips Removed

5.2.7

AIR-IN-LINE TEST

To perform the air-in-line test, proceed as follows:

1. Insert special cassette marked AIR, with the distal bubble sensor tips removed (*see Figure 5-4, Infusion System Cassettes with Bubble Sensor Tips Removed*).
2. Attach starter and close door.
3. Press [YES] in response to SAVE SETTINGS.
4. Press [YES] in response to FINISH PRIMARY DOSE. Press [START].
5. Before delivery of 6 mL, verify the alarm sounds and that one of the following messages appears on the LCD screen: STOPPED CHECK SET REPRIME SET or STOPPED AIR IN DISTAL LINE PRESS RESET.
6. Press [RESET] to silence alarm. Verify the LCD screen displays: IN RESET OPEN DOOR AND REPRIME SET.
7. Open and close door. Press [NO] in response to SAVE SETTINGS; press [YES] in response to CLEAR VOLUME.

5.2.8

BATTERY CHARGER TEST

To perform the battery charger test, proceed as follows:

1. Clear all rates and volumes, then disconnect the infusion system from AC (mains) power.
2. Simultaneously open door and start stopwatch. In approximately 10 seconds, the LCD screen dims completely and battery symbol deactivates.
3. Remove cassette and close door.

4. Remove the battery pack cover and disconnect the battery pack from the charger by disconnecting the battery cable (*see Section 7.2.2, Battery Pack Replacement).*
5. Connect resistor-capacitor network to charger connector at one end and to DMM at other end.
6. Connect the infusion system to AC (mains) power and measure voltage across the network with DMM set to 0 to 100 voltage scale. DMM should read 9.4 ± 0.1 VDC. Voltage for infusion systems with Service Revision M and higher, or with a battery charger PWA, should read 13 ± 2 VDC.
7. Disconnect resistor-capacitor network and AC (mains) power.
8. Reconnect battery pack and replace battery cover.

5.2.9
CONCURRENT DELIVERY TEST

To perform the concurrent delivery test, proceed as follows:

1. Set operating parameters as follows:

   Primary delivery rate: 400 mL/hr

   Primary dose limit: 100 mL/hr

   Press [YES] in response to SET SECONDARY

   Press [YES] in response to SET CONCURRENT DELIVERY

   Secondary delivery rate: 200 mL/hr

   Secondary dose limit: 50 mL
2. Press [START] and verify the LCD screen displays: PUMPING-CONCURRENT.
3. Verify that pumping occurs alarm-free for one minute.

5.2.10
DELIVERY ACCURACY TEST

Note: Accuracy testing is for informational purposes only, and is not to be used as a re-release test. If there is any concern regarding infusion system accuracy, return the infusion system to Abbott Laboratories.

To perform the delivery accuracy test, proceed as follows:

1. Insert needle or adapter of primed secondary set into cassette secondary inlet.
2. Verify the infusion system DIP switches are set for MACRO SECONDARY MODE (dual channel, single dose), as described in *Section 5.2.3, Start-Up Test.* Set the remaining operating parameters as follows:

   Primary delivery rate: 400 mL/hr

   Primary dose limit: 10 mL. Press [YES] in response to SET SECONDARY. Press [NO] in response to CONCURRENT DELIVERY

   Secondary delivery rate: 400 mL/hr

   Secondary dose limit: 10 mL
3. Press [NO] in response to SECONDARY OVERFILL.
4. Place distal needle into cylinder graduate and press [START].

5. Verify pumping action.
6. After DOSE END and KVO appear on the LCD screen display, a flashing 1 appears on the LED display and an alarm sounds. Press [RESET].
7. To observe total volume, press [YES] in response to REPEAT PRIMARY, then press [CLEAR] and observe total volume of 20 mL. Press [YES] to clear. The volume in the graduated cylinder should be between 19 and 21 mL.
8. Disconnect infusion system from AC (mains) power.
9. Open door and start stopwatch; if battery symbol remains illuminated for more than 10 seconds, memory reserve is functional.
10. Reconnect infusion system to AC (mains) power.
11. Close door. At end of self test, clear all operating parameters by pressing [SILENCE/NO] and [YES/ENTER].

Note: If the infusion system fails to deliver properly, reprime cassette and repeat test. If the infusion system again fails to deliver properly, contact Abbott Laboratories (*see Section 6.1, Technical Assistance*).

5.2.11
PRESSURE SENSOR TEST

To perform the pressure sensor test, proceed as follows:

1. Set the operating parameters as follows:

   Primary delivery: 400 mL/hr

   Primary dose limit: 50 mL

   Secondary delivery: 400 mL/hr

   Secondary dose limit: 4 mL

   Occlusion pressure: 4 psig (28 kPa) (accessed through the [REVIEW/CHANGE] touchswitch)
2. Clamp secondary line near inlet site. Within five infusion system strokes, an alarm sounds, and the LCD screen displays: PROXIMAL OCCLUSION SECONDARY.
3. Press [RESET] and unclamp tubing.
4. Press [START]. The infusion system delivers the remaining secondary dose and begins primary delivery.
5. When primary section has pumped 1 mL of fluid, close upper slide clamp. Within five infusion system strokes, an alarm sounds, and the LCD screen displays: PROXIMAL OCCLUSION-PRIMARY.
6. Press [RESET] and open the upper slide clamp.
7. Connect a 21-gauge needle to a plastic syringe which has been opened to 20 cc.
8. Insert syringe and needle into the lower Y site of distal tubing.
9. Connect distal tubing to DPM through three-way stopcock as shown in *Figure 5-5, Pressure Sensor Test Setup.*

   Note: Height of DPM must be 0 ± 6 inches (0 ± 15 cm) from the midline of the cassette.
10. Open stopcock to air.

Note: To keep plunger from coming out during the test, secure the syringe and plunger.

11. Press [START] and allow the infusion system to stabilize for at least one minute.
12. Set the stopcock to measure pressure.
13. Press [REVIEW/CHANGE] four times to read pressure according to the infusion system.
14. Confirm an alarm sounds and the LCD screen displays: DISTAL LINE OCCLUSION. Confirm the pressure meter displays 4 ± 1 psig (27.6 ± 6.9 kPa).
15. While the infusion system is in occlusion, turn the audible alarm switch to all three positions; confirm all stages operate correctly.
16. Press [RESET].
17. Set infusion system pressure to 8 psig (55 kPa) and repeat Steps 11 through 16 (omitting Step 15). At occlusion, the pressure meter should display 8 ± 1.5 psig (55.1 ± 10.3 kPa).
18. Remove needle from the Y site and distal tubing from the stopcock.

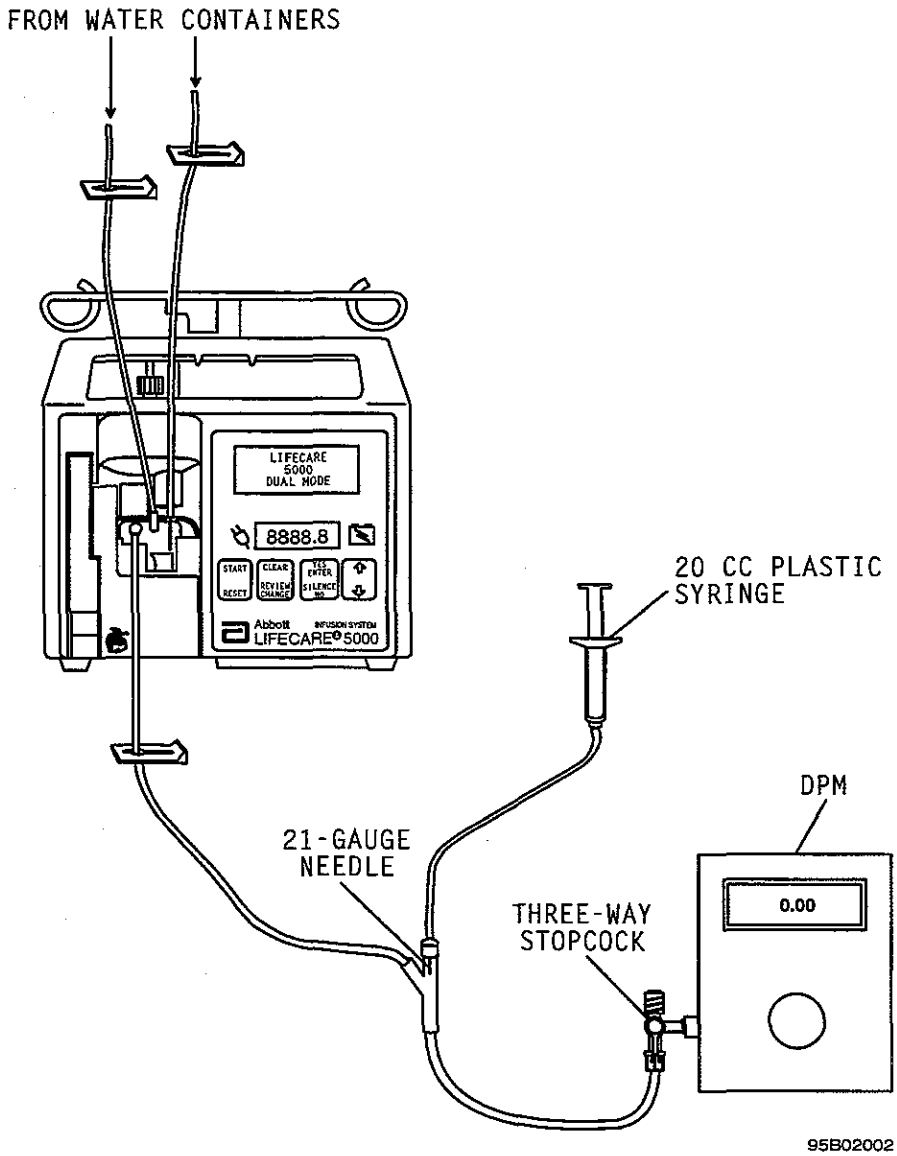


Figure 5-5. Pressure Sensor Test Setup

5.2.12

ELECTRICAL SAFETY TEST

To perform the electrical safety test, proceed as follows:

1. Connect the infusion system to a safety analyzer. Leakage current should be greater than 2 microamperes (open ground), but should not exceed 50 microamperes.
2. Using the safety analyzer, measure resistance of AC (mains) connector ground lug. Resistance should not exceed 0.1 ohm.

5.2.13

END OF PERFORMANCE VERIFICATION TEST (1.5 SERIES)

At completion of the PVT, proceed as follows:

1. Clear dose history. Open and close door. When SAVE SETTINGS appears on the LCD screen, press the [NO] touchswitch.
2. If all tests are successful, return infusion system to service. If any of the tests fail, refer to *Section 6, Troubleshooting*, or contact Abbott Laboratories.
3. Reset the mode DIP switches to previous configuration.

5.3

PERFORMANCE VERIFICATION TEST (1.6 SERIES)

As a part of a preventive maintenance schedule, it is recommended that the PVT be conducted periodically per hospital procedures for compliance to accreditation requirements.

Note: To document test results, PVT data forms for 1.6 series infusion systems are provided in *Section 5.5*.

The PVT consists of the tests described in the following sections. These tests are used for diagnostic purposes during the troubleshooting of a malfunctioning infusion system, and for verification of the overall performance of an infusion system as part of a preventive maintenance schedule. In addition, the PVT should be used for performance verification before an infusion system is placed back in service after repair.

Note: It is essential the PVT be performed exactly as described in this manual to assure effective and reliable product evaluation information.

Section 5.3 consists of the PVT for 1.6 series infusion systems. For performance testing of 1.5 series infusion systems, use the PVT in *Section 5.2*.

5.3.1

EQUIPMENT AND MATERIALS REQUIRED

The equipment and materials or equivalents required to perform the PVT for 1.6 series infusion systems follow:

- ❑ Safety analyzer, Dynatech Nevada Model 231D
- ❑ DPM, 0 to 50 psig (0 to 345 kPa), Bio-Tek DPM II
- ❑ 21-gauge needle, List No. 4492
- ❑ Nurse-call test cable or equivalent 1/4 inch phone jack to banana plug, P/N 561-88416-001
- ❑ Three-way stopcock, List No. 3233
- ❑ 470 ohm/100 microfarad, resistor/capacitor parallel network, P/N 561-88419-001
- ❑ DMM, Fluke Model 77
- ❑ Two containers of sterile water, List No. 7973-08, or tap water
- ❑ IV sets, List Nos. 6426-02 and 3047-01
- ❑ 20 cc plastic syringe, volume limited at 20 cc
- ❑ 25 mL graduated cylinder (0.2 graduations)
- ❑ No. 2 Phillips screwdriver
- ❑ Hex nutdriver set
- ❑ Stopwatch
- ❑ Recirculating set, List No. 6426-02, with proximal sensor bulb tips removed from cassette, and marked EMPTY on the cassette
- ❑ Recirculating set, List No. 6426-02, with distal sensor bulb tips removed from cassette, and marked AIR on the cassette
- ❑ PCXT or compatible computer (to perform PVT on infusion systems with DataPort)
- ❑ Infusion system DataPort to PC cable (to perform PVT on infusion systems with DataPort)
- ❑ Bubble sensor location fixture, P/N 561-81402-001*
- ❑ Bubble sensor location calibration block (calibration block), P/N 561-81402-006*

***Note**: The bubble sensor location fixture and calibration block are required only when performing the bubble sensor location test.

5.3.2

INSPECTION

Before starting the tests, thoroughly inspect the infusion system as detailed in *Section 5.1.1, Inspecting the Infusion System.*

5.3.3

START-UP TEST

WARNING

A PATIENT SHOULD NEVER BE CONNECTED TO THE INFUSION SYSTEM DURING TESTING.

The following tests are conducted with the infusion system in the MACRO SECONDARY MODE (dual channel, single dose). When the infusion system is in this mode, the LCD screen displays: LIFECARE 5000 DUAL CHANNEL. Before starting the PVT, note the configuration of the DIP switches and place the infusion system in the MACRO SECONDARY MODE as necessary. Refer to *Section 1.9, Setting the Delivery Mode*, for information on DIP switch settings for the desired mode. See also *Figure 1-1, DIP Switch Settings for Each Delivery Mode.* At the conclusion of the PVT, reset DIP switches to the previous settings.

Note: For all testing, the vertical distance from the top of the fluid in the flexible container to midline of the cassette must be 18 ± 6 inches (46 ± 15 cm).

To perform the start-up test, proceed as follows:

1. Insert the primed IV set with 21-gauge needle attached to the distal line end, into the door. Close the door and verify the red battery power symbol illuminates.
2. Connect infusion system to an AC (mains) outlet and verify the green AC (mains) power symbol illuminates.

   Note: Complete the remainder of the PVT with the infusion system connected to AC (mains) power, except as specified.

3. To verify that all touchswitches emit one short tone or flutter, press each touchswitch in sequence as follows:

   [START]

   [RESET]

   [REVIEW/CHANGE]

   [SILENCE/NO]

   Down Arrow

   Up Arrow

   [YES/ENTER]

   [CLEAR]
4. Press all touchswitches again except [START] and [CLEAR] in same sequence as described in Step 3; verify that no tones sound. Press [CLEAR] and listen for flutter.
5. Press all touchswitches again as described in Step 3; listen for tone or flutter.
6. Optional. Open and reclose door; observe that all LEDs and the LED decimal point illuminate immediately. When SELF TEST:OK prompt appears, press [REVIEW] to view software revision. Press [REVIEW] again to view alarm history.)

Note: Throughout this manual, a touchswitch, such as [REVIEW/CHANGE], may be referred to by the name that most closely describes its function in a particular procedure. For example, the [REVIEW/CHANGE] touchswitch is referred to as the [REVIEW] touchswitch in Step 6.

5.3.4

BUBBLE SENSOR LOCATION TEST

To perform the bubble sensor location test, refer to *Figure 5-6, Gauge Dial Indicator.* Standardize the gauge of the bubble sensor location fixture, as follows:

1. Place calibration block (boss end) of bubble sensor location fixture over each contact pin, holding the block flush to the base of fixture.
2. Check gauge dial indicators for 0 reading on outer scale and 1 inner revolution indicator. Adjust bezel to 0 as necessary by loosening bezel clamp. Retighten after adjustment is made.

After standardizing the fixture, perform the bubble sensor location test as follows:

1. Insert bubble sensor location fixture in cassette door and close door.
2. Verify that both dial indicators read 1 revolution ± 0.010.
3. Open cassette door and remove fixture.

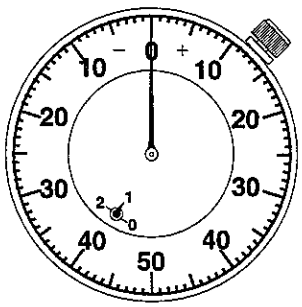


Figure 5-6. Gauge Dial Indicator

5.3.5

NURSE-CALL TEST

Note: The following test may be bypassed if the nurse-call function is not used.

To perform the nurse-call test, attach the nurse-call cable, then proceed as follows:

1. Set primary delivery rate to 400 mL/hr and primary dose limit to 1 mL.
2. Connect DMM to nurse-call cable.
3. Press [START] and verify pumping action.
4. After DOSE END and KVO appear on the LCD screen, observe a short circuit on DMM (approximately 1 ohm on 0 to 100 ohms scale).

5.3.6

EMPTY CONTAINER TEST

To perform the empty container alarm test, proceed as follows:

1. Insert the recirculating set with cassette marked EMPTY, with the proximal bubble sensor bulb tips removed and close the door (*see Figure 5-7, Recirculating Set Test Setup,* and *Figure 5-8, Infusion System Cassettes with Bubble Sensor Tips Removed*).

2. Set RATE to 400 mL/hr and press [ENTER].
3. Set DOSE LIMIT to 10 mL and press [ENTER].
4. Press [NO] in response to SET SECONDARY.
5. Press [START] and confirm that pumping occurs. Confirm that an alarm sounds. Within 30 seconds, confirm the following message appears on the LCD screen: STOPPED AIR IN PROXIMAL LINE PRESS RESET.
6. Open door and remove cassette.

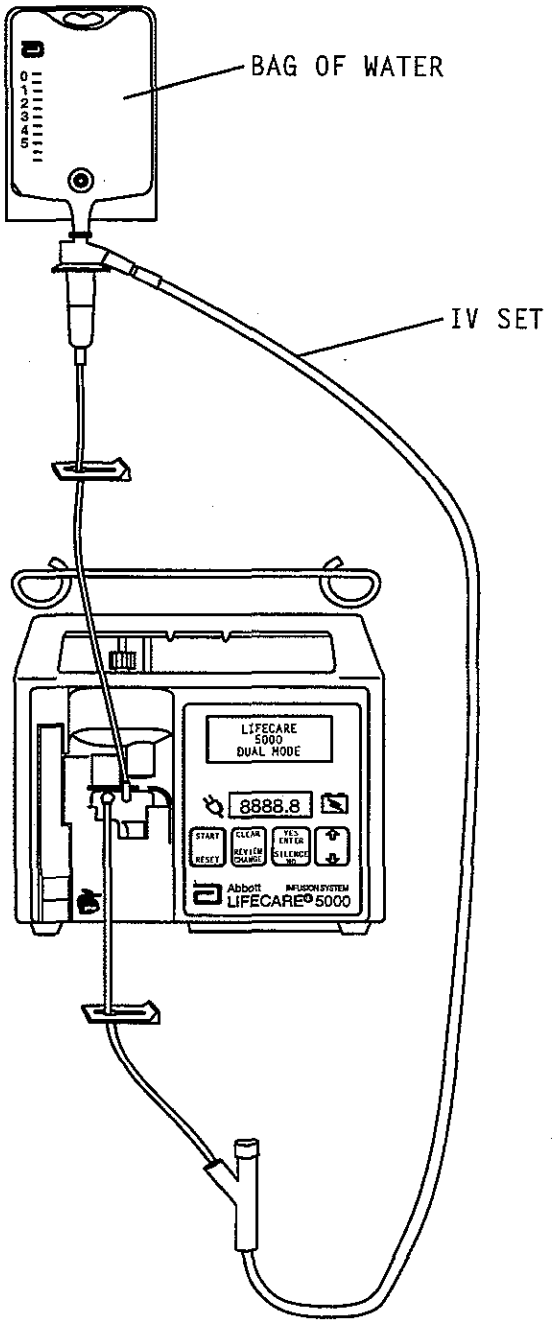


Figure 5-7. Recirculating Set Test Setup

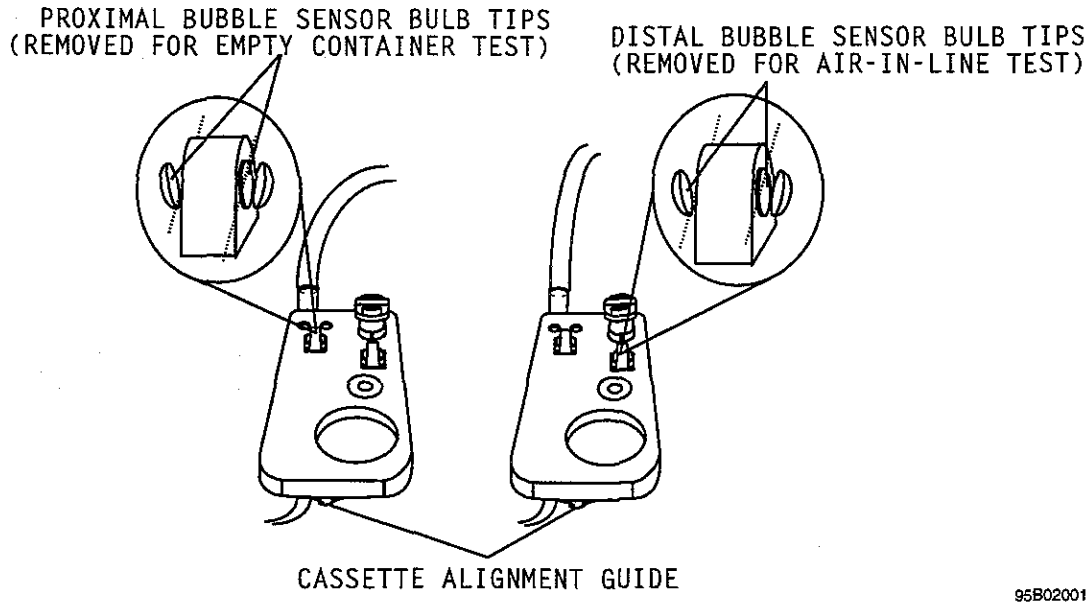


Figure 5-8. Infusion System Cassettes with Bubble Sensor Tips Removed

5.3.7

AIR-IN-LINE TEST

To perform the air-in-line test, proceed as follows:

1. Insert the recirculating set with cassette marked AIR, and with distal bubble sensor bulb tips removed (*see Figure 5-7, Recirculating Set Test Setup,* and *Figure 5-8, Infusion System Cassettes with Bubble Sensor Tips Removed).*
2. Close the cassette door and press [YES] in response to SAVE SETTINGS.
3. Press [YES] in response to FINISH PRIMARY DOSE; press [START].
4. Verify that an alarm sounds. Within 30 seconds, verify the following message appears on the LCD screen: STOPPED AIR IN DISTAL LINE PRESS RESET.
5. Press [RESET]; open and close door. Press [NO] in response to SAVE SETTINGS. Press [NO] in response to RETAIN VOLUME.

5.3.8

BATTERY CHARGER TEST

To perform the battery charger test, proceed as follows:

1. Clear all rates and volumes. Disconnect infusion system from AC (mains) power.
2. Open the door. Within 30 seconds, the LCD screen should dim completely and the battery symbol should deactivate.
3. Remove cassette and close door.
4. Remove battery pack cover and disconnect battery pack from charger by disconnecting battery cable (*see Section 7.2.2, Battery Pack Replacement).*
5. Connect resistor-capacitor network to charger connector at one end and to DMM at other end.

6. Connect infusion system to AC (mains) power and measure voltage across network with DMM set to 0 to 100 voltage scale. DMM should display 13 ± 2 VDC.
7. Disconnect resistor-capacitor network and AC (mains) power.
8. Reconnect battery pack and replace battery pack cover.

5.3.9
DELIVERY ACCURACY TEST

Note: Accuracy testing is for informational purposes only, and is not to be used as a re-release test. If there is any concern as to infusion system accuracy, return the infusion system to Abbott Laboratories.

To perform the delivery accuracy test, proceed as follows:

1. Insert needle or adapter of primed secondary set into cassette secondary inlet.
2. Confirm the infusion system DIP switches are set for MACRO SECONDARY MODE (dual channel, single dose), as described in *Section 5.3.3, Start-Up Test.* Set operating parameters as follows:

   Primary delivery rate: 400 mL/hr

   Primary dose limit: 10 mL. Press [YES] in response to SET SECONDARY. Press [NO] in response to CONCURRENT DELIVERY

   Secondary delivery rate: 400 mL/hr

   Secondary dose limit: 10 mL
3. Press [YES] in response to CALL BACK AT SECONDARY DOSE END. Press [NO] in response to CONTINUE SECONDARY AT DOSE END. Press [NO] in response to DELIVER SECONDARY OVERFILL.
4. Place distal needle into graduated cylinder and press [START].
5. If flow detector is used, attach to primary drip chamber and connect cable to port on back of infusion system.
6. Verify pumping action.
7. At end of secondary, verify the following message appears on the LCD screen: SEC DOSE END PUMPING PRIMARY PRESS SILENCE
8. Press [SILENCE]. In response to REPEAT SECONDARY, press [NO].
9. If testing flow detector, verify that infusion system operation is alarm free during primary delivery.
10. After DOSE END and KVO appear on the LCD screen, a flashing 1 appears on the LED display, and an alarm sounds, press [RESET].
11. To observe total volume, press [YES] in response to REPEAT PRIMARY. Press [CLEAR]; observe total volume of 20 mL. Press [YES] to clear. The volume in the graduated cylinder should be between 19 and 21 mL.

Note: If the infusion system fails to deliver properly, reprime cassette and repeat test. If the infusion system again fails to deliver properly, contact Abbott Laboratories.

5.3.10
PRESSURE SENSOR TEST

To perform the pressure sensor test, proceed as follows:

1. Set operating parameters as follows:

   Primary delivery rate: 400 mL/hr

   Primary dose limit: 100 mL. Press [NO] in response to SET SECONDARY

   Occlusion pressure: 4 psig (27.6 kPa) (accessed by pressing the [REVIEW/CHANGE] touchswitch)
2. Connect a 21-gauge needle to a plastic syringe which has been opened to 20 cc.
3. Insert syringe and needle into the lower Y site of distal tubing.
4. Connect distal tubing to DPM through a three-way stopcock, as shown in *Figure 5-5, Pressure Sensor Test Setup.*

   Note: Height of DPM must be 0 ± 6 inches (0 ± 15 cm) from the midline of the cassette.
5. Open stopcock to air.
6. Press [START] and allow infusion system to stabilize for at least one minute.

   Note: To keep plunger from coming out during the test, secure the syringe and plunger.
7. Set the stopcock to measure pressure.
8. Press [REVIEW/CHANGE] until the LCD screen displays the pressure according to the infusion system under test.
9. Verify STOPPED DISTAL LINE OCCLUSION alarm status on LCD screen.
10. DPM should display 4.0 ± 1.0 psig (27.6 ± 6.9 kPa).
11. While the infusion system is in occlusion, turn the audible alarm switch to all three positions and make certain that audible levels operate correctly.
12. Press [RESET].
13. Set infusion system pressure to 8 psig (55 kPa) and repeat Step 5 through Step 12 (omitting Step 11). At occlusion, the DPM should display 8 ± 1.5 psig (55.1 ± 10.3 kPa).
14. Remove needle from the Y site and distal tubing from the stopcock. Place distal tubing in waste receptacle or recirculate.
15. Open and close door; press [NO] to save settings.
16. Set operating parameters as follows:

   Primary delivery rate: 200 mL/hr

   Primary dose limit: 10 mL. Press [YES] in response to SET SECONDARY. Press [YES] in response to CONCURRENT.

   Secondary delivery rate: 200 mL/hr

   Secondary dose limit: 10 mL. Press [NO] in response to CALLBACK AT SECONDARY DOSE END. Press [NO] in response to DELIVER SECONDARY OVERFILL
17. Press [START] and allow system to stabilize for at least one minute.
18. After a minimum of two cycles, clamp proximal primary tubing just below drip chamber. Verify the LCD screen displays: STOPPED PROX. OCCLUSION PRIMARY, and an alarm sounds within three pumping cycles.
19. Press [RESET] and unclamp the tubing; open the door.

5.3.11
ELECTRICAL SAFETY TEST

To perform the electrical safety test, proceed as follows:

1. Connect the infusion system to the safety analyzer. Leakage current should be greater than 2 microamperes (open ground), but should not exceed 50 microamperes.
2. Using a safety analyzer, measure the resistance of AC (mains) connector ground lug. Resistance should not exceed 100 milliohms (0.1 ohm).

5.3.12
DATAPORT COMMUNICATION TEST

Note: The following procedure may be bypassed if the DataPort communications feature is not used.

The following program, written in BASIC, tests the DataPort communications hardware of the infusion system.

To perform the DataPort communication test, connect the DataPort host computer directly to the infusion system DataPort connector and run the following program. See *Figure 7-13, DataPort Accessory Cable Schematics*, and *Table 7-1, Accessories for 1.6 Series Infusion Systems*, for proper hardware connections.

```
 10 REM ************************************************************
 20 REM ***
 30 REM * Program:    LCTEST.BAS       REV:1.01
 40 REM * Description:
 50 REM    This program will test the hardware of the LC5000
 60 REM    DATAPORT system. A single packet will be sent to the
 70 REM    pump and one will be expected in reply. The CRC is
 80 REM    pre-calculated. This program will communicate with only
 90 REM    one pump—communication with multiple pumps on a single
100 REM    bus line will not function with this program.
110 REM * Interpreter : IBM BASIC Version 2.0
120 REM ***
130 REM ************************************************************
140 REM *** Beginning of program.
150 REM *** Clear computer screen.
160 CLS
170 REM *** Indicate "no packets received".
180 LCSTR$ = ""
190 LCLEN = 0
200 REM *** If error then report failure of computer port.
210 ON ERROR GOTO 450
220 REM *** Activate communication port on the computer:
230 REM ***   port = 1, baud rate = 1200, parity = none,
240 REM ***   data bits = 8, stop bits = 1.
250 COM(1) ON
260 ON COM(1) GOSUB 530
270 OPEN "COM1:1200,N,8,1" AS #1
280 REM *** Send packet to pump:
```

```
290 REM ***  Flush and ask for status from Hard-ID 0.
300 PRINT #1,CHR$(3);
310 PRINT #1,"T@0;ISTA;2FAD"
320 REM *** Wait for a reply packet from pump.
321 REM *** To reduce the waiting period for the reply packet
322 REM *** to be sent from the pump to the PC, the loop
323 REM *** counter (25000) in line 330 may be reduced as
324 REM *** required to a minimum of 1500.
330 FOR I=1 TO 25000
340 NEXT
350 REM *** Test for a received packet. If received packet is empty
360 REM *** then test FAILS. Otherwise, test PASSes and the received
370 REM *** packet is printed.
380 REM ***
390 IF LCLEN = 1 THEN GOTO 400  ELSE GOTO 420
400 PRINT "** TEST PASSED, received packet:";LCSTR$
410 GOTO 500
420 PRINT "** TEST FAILED, no communication from pump."
430 GOTO 500
440 REM *** Communication port error.
450 PRINT CHR$(13);CHR$(13);CHR$(13)
460 PRINT "Communication ERROR on COM1 port—check cable connections."
470 GOTO 510
480 REM *** Close communication port.
490 COM(1) OFF
500 CLOSE
510 END
520 REM *** Receive the packet.
530 INPUT #1,LCSTR$
540 COM(1) OFF
550 LCLEN = 1
560 RETURN
570 REM *** End of program.
```

If TEST PASSED is displayed at the end of the program, the infusion system communication hardware and software are functioning properly. If TEST FAILED is displayed at the end of the program, re-enter program. If TEST FAILED is still displayed, refer to the DataPort malfunctions in *Table 6-2, Troubleshooting DataPort Systems (1.6 DataPort Only)*, or contact Abbott Laboratories.

5.3.13

END OF PERFORMANCE VERIFICATION TEST (1.6 SERIES)

At the completion of the PVT, proceed as follows:

1. Clear dose history. Open and close door. When SAVE SETTINGS appears on the LCD screen, press the [NO] touchswitch.
2. If all tests are successful, return infusion system to service. If any of the tests fail, refer to *Section 6, Troubleshooting*, or contact Abbott Laboratories.
3. Reset DIP switches to previous configuration.

This page intentionally left blank.

5.4
PVT DATA FORM VERSION 1.5

List Number:_____(Version 1.5___) Serial Number:_____

Maintenance and Service Tests for LC 5000

Inspection

1. Inspect the electrical cord and nurse-call cable for damage or foreign material.	Pass___	Fail___
2. Inspect the case for cracks or stains.	Pass___	Fail___
3. Inspect the pole clamp and pads for damage.	Pass___	Fail___
4. Verify that the control panel switches have no cracks or other damage.	Pass___	Fail___
5. Inspect the accessory and flow detector connectors for cracked housing and broken/bent pins.	Pass___	Fail___
6. Inspect the face plate for any damage.	Pass___	Fail___
7. Verify that the four bottom pressure pads (feet) are present and do not have excessive wear.	Pass___	Fail___
8. Verify that the Velcro strap is present.	Pass___	Fail___
9. Verify that the minipole and clutch spring are not damaged.	Pass___	Fail___
10. Inspect the door assembly for damage or foreign material.	Pass___	Fail___

Start-Up Test

Verify that the IV set is primed.

1. Verify that the red battery power symbol illuminates when the infusion system is on battery power.	Pass___	Fail___
2. Verify that the green AC (mains) symbol illuminates when the infusion system is connected to AC (mains) power.	Pass___	Fail___
3. Verify that all touchswitches emit a short tone or flutter tone.	Pass___	Fail___
4. Verify that after pressing the CLEAR key the touchswitches do not emit tone.	Pass___	Fail___
5. After pressing CLEAR again, verify touchswitches emit tone.	Pass___	Fail___
6. Record software revision.	Rev._____	

Delivery Accuracy Test

1. Delivery of 20 mL into a 25 mL graduated cylinder Delivery of _____ mL (specification = 19.0 to 21.0)	Pass___	Fail___
2. Open the door and verify that battery symbol remains illuminated for more than 10 seconds.	Pass___	Fail___

Nurse Call Test

1. Verify after DOSE END that nurse call cable indicates a short circuit (0 to 1 ohm).	Pass___	Fail___

Empty Container Test

1. Verify that STOPPED AIR IN PROXIMAL LINE PRESS RESET or STOPPED CHECK SET REPRIME SET message with an audible alarm occurs within three pumping cycles after starting infusion system with EMPTY simulated cassette.	Pass___	Fail___

Air in Line Test

1. Verify that STOPPED CHECK SET REPRIME SET message or AIR IN DISTAL LINE PRESS RESET with an audible alarm occurs prior to delivering 6 mL after starting infusion system with AIR in LINE simulated cassette. Pass___ Fail___

Pressure Sensor Test

1. Verify the proximal occlusion alarm occurs within 5 pumping cycles after closing secondary line and PROXIMAL OCCLUSION SECONDARY message appears. Pass___ Fail___
2. Verify the proximal occlusion alarm occurs within 5 pumping cycles after closing primary line and PROXIMAL OCCLUSION PRIMARY message appears. Pass___ Fail___
3. Observe the DISTAL LINE OCCLUSION alarms at the following pressure settings:
   4 psi (27.6 kPa) Reading_____ Specification = 3 to 5 psi (20.7 to 34.5 kPa) Pass___ Fail___
   8 psi (55.1 kPa) Reading_____ Specification = 6.5 to 9.5 psi (44.8 to 65.4 kPa) Pass___ Fail___

Bubble Sensor Location Test

1. Insert bubble sensor fixture into cassette door and close. Verify that both indicators read 1 revolution ± .010. Pass___ Fail___

Concurrent Delivery Test

1. Verify concurrent delivery and no alarm for one minute. Pass___ Fail___

Battery Charger Test

1. Disconnect battery and connect resistor capacitor network to charger connections. Measure the voltage across the RC network. Pass___ Fail___
   Reading_____ VDC
   Specification = 9.4 ± 0.1 VDC or 13.0 ± 2.0 VDC with Battery Boost.

Electrical Safety Test

1. Record leakage current. _____ Acceptable result < 50 µA. Pass___ Fail___
2. Record ground resistance. _____ Acceptable result < 0.1 ohms. Pass___ Fail___

Performance Verification Test performed by:_____ Date: _____

Test Equipment:

Pressure Meter # _____
Safety Analyzer # _____
DMM # _____
Bubble Sensor Fixture # _____

5.5
PVT DATA FORM VERSION 1.6

List Number:_____(Version 1.6___) Serial Number:_____

Maintenance and Service Tests for LC 5000

Inspection

1.	Inspect the electrical cord and nurse-call cable for damage or foreign material.	Pass___	Fail___
2.	Inspect the case for cracks or stains.	Pass___	Fail___
3.	Inspect the pole clamp and pads for damage.	Pass___	Fail___
4.	Verify that the control panel switches have no cracks or other damage.	Pass___	Fail___
5.	Inspect the accessory and flow detector connectors for cracked housing and broken/bent pins.	Pass___	Fail___
6.	Inspect the face plate for any damage.	Pass___	Fail___
7.	Verify that the four bottom pressure pads (feet) are present and do not have excessive wear.	Pass___	Fail___
8.	Verify that the Velcro strap is present.	Pass___	Fail___
9.	Verify that the minipole and clutch spring are not damaged.	Pass___	Fail___
10.	Inspect the door assembly for damage or foreign material.	Pass___	Fail___
11.	Verify the flow detector is not damaged (if applicable).	NA___ Pass___	Fail___
12.	Inspect the junction box for damage (if applicable).	NA___ Pass___	Fail___

Start-Up Test

Verify that the IV set is primed.

1.	Verify that the red battery power symbol illuminates when the infusion system is on battery power.	Pass___	Fail___
2.	Verify that the green AC (mains) symbol illuminates when the infusion system is connected to AC (mains) power.	Pass___	Fail___
3.	Verify that all touchswitches emit a short tone or flutter tone.	Pass___	Fail___
4.	Verify that after pressing the CLEAR key the touchswitches do not emit tone.	Pass___	Fail___
5.	After pressing CLEAR again, verify touchswitches emit tone.	Pass___	Fail___
6.	Record software revision.	Rev._____	

Delivery Accuracy Test

1.	Delivery of 20 mL into a 25 mL graduated cylinder Delivery of_____ mL (specification = 19.0 to 21.0)	Pass___	Fail___

Nurse Call Test

1.	Verify after DOSE END that nurse call cable indicates a short circuit (0 to 1 ohm).	Pass___	Fail___

Pressure Sensor Test

1.	Observe the STOPPED DISTAL LINE OCCLUSION alarm at the following pressure settings: 4 psi (27.6 kPa) Reading_____ Specification = 3 to 5 psi (20.7 to 34.5 kPa)	Pass___	Fail___
	8 psi (55.1 kPa) Reading_____ Specification = 6.5 to 9.5 psi (44.8 to 65.4 kPa)	Pass___	Fail___
2.	Verify the Proximal Occlusion Alarm occurs within 3 pumping cycles after closing proximal line and STOPPED PROX. OCCLUSION PRIMARY message appears.	Pass___	Fail___

Bubble Sensor Location Test

1. Insert Bubble Sensor fixture into cassette door and close. Verify that both indicators read 1 revolution ± .010. Pass___ Fail___

Empty Container Test

1. Verify that STOPPED AIR IN PROXIMAL LINE PRESS RESET message with an audible alarm occurs within 30 seconds after starting infusion system with EMPTY simulated cassette. Pass___ Fail___

Air in Line Test

1. Verify that STOPPED AIR IN DISTAL LINE PRESS RESET message with an audible alarm occurs within 30 seconds after starting infusion system with AIR IN LINE simulated cassette. Pass___ Fail___

Battery Charger Test

1. Disconnect battery and connect resistor capacitor network to charger connections. Measure the voltage across the RC network. Reading_____ VDC
   Specification = 13 ± 2.0 VDC Pass___ Fail___

Electrical Safety Test

1. Record leakage current. _____ Acceptable result < 50 µA. Pass___ Fail___
2. Record ground lug resistance. _____ Acceptable result < 0.1 ohms. Pass___ Fail___

DataPort Communication Test (optional)

1. Verify that DataPort communication test is successful. NA___ Pass___ Fail___

Performance Verification Test performed by:_____ Date: _____

Test Equipment:

Pressure Meter # _____
Safety Analyzer # _____
DMM # _____
Bubble Sensor Fixture # _____

Section 6

TROUBLESHOOTING

This section contains information on obtaining technical assistance from Abbott Laboratories. Also included is information on audible alarms, alarm and malfunction codes, and infusion system troubleshooting. For infusion systems operating with 1.6 series software, all alarm and malfunction codes detailed in this section can be monitored by a host computer connected to infusion systems with the DataPort communications feature.

6.1 TECHNICAL ASSISTANCE

For technical assistance, product return authorization, and to order parts, accessories, or manuals within the United States, contact Abbott Laboratories Technical Support Operations.

1-800-241-4002

Send all authorized, prepaid returns to the following address:

Abbott Laboratories
Technical Support Operations
960 Linda Vista Avenue
Mountain View, California 94043

From outside the United States, contact the nearest Abbott Laboratories representative.

6.2 AUDIBLE ALARMS

The infusion system alerts the user to an abnormal condition with an audible alarm. An audible alarm sounds either a continuous alarm tone, indicating a power failure, or a tone sequence of short-long-short-long. These short-long-short-long tones indicate the infusion system is in the alarm state (*see Section 4.2, Alarm Conditions*). The infusion system automatically enters an alarm state whenever it detects an alarm condition. Infusion is prohibited during all audible alarm conditions unless otherwise indicated.

The following sections briefly describe alarm messages, alarm conditions, and obtaining an alarm history for 1.5 series and 1.6 series infusion systems.

6.2.1
ALARM MESSAGES

Under certain alarm conditions, the infusion system stops operating, generates an audible alarm, displays an alarm code, and an alarm message on the LCD screen. Alarm codes 06, 07, 08, 09, 0A, 12, 13, 14, and 15 display an initial alarm message on the LCD screen, followed by a secondary alarm message. There are two categories of alarm codes: codes that can be cleared by the operator and codes that require the assistance of qualified service personnel.

Table 6-1, Alarm Codes and Corrective Actions, lists alarm codes, LCD screen messages, possible causes, corrective actions, and DataPort codes. Alarm codes listed in *Table 6-1* are hexadecimal in value from $00_{(16)}$ to $FF_{(16)}$. The LCD screen message column differentiates alarm codes as operator-cleared messages or malfunction codes requiring the assistance of qualified service personnel. Operator alarm messages are corrected using corrective actions described in the system operating manual. DataPort codes apply only to 1.6 series infusion systems with DataPort.

CAUTION: For those patients who are likely to be adversely affected by unintended operations and failures, including interrupted medication or fluid delivery from the infusion system, close supervision and provision for immediate corrective action should be provided.

CAUTION: If excessive alarms occur, contact Abbott Laboratories.

Table 6-1. Alarm Codes and Corrective Actions

ALARM CODE	LCD SCREEN MESSAGE	POSSIBLE CAUSE	CORRECTIVE ACTION	DATA-PORT CODE
00	(No message, no alarm. Alarm code history displays all zeros)	New infusion system, no alarms recorded	None	OK
		System disconnected from AC (mains) power and battery pack removed	Replace battery pack	

Table 6-1. Alarm Codes and Corrective Actions

ALARM CODE	LCD SCREEN MESSAGE	POSSIBLE CAUSE	CORRECTIVE ACTION	DATA-PORT CODE
01	STOPPED DISTAL LINE OCCLUSION PRESS RESET	Distal line occlusion: Excessive line pressure	Check clamps	OD1
		Distal line kinked; distal clamp closed; clotted IV site	Examine distal line for kinks in tubing or internal obstructions	
		Infusion system positioned incorrectly	Reposition infusion system at or above patient mid-axillary line	
		Pressure limit set too low	Raise pressure limit if therapy permits	
		Pressure sensor out of calibration	Replace mechanism assembly (*refer to Section 7.2.18.2 or Section 7.2.19.2)*	
02	(Code not used; no alarm)			
03	STOPPED PROX. OCCLUSION PRIMARY PRESS RESET	Primary proximal line occlusion	Check clamps and filters. Check for kinks in tubing, or internal obstructions. Verify 19-gauge or larger needle is used	OP1
		Defective administration set	Replace set	
04	STOPPED PROX. OCCLUSION SECONDARY PRESS RESET	Secondary proximal line occlusion	Check clamps and filters. Check for kinks in tubing and internal obstructions. Verify 19-gauge or larger needle is used	OP2
		Single channel administration set used for dual delivery	Replace with dual-channel administration set	

Table 6-1. Alarm Codes and Corrective Actions

ALARM CODE	LCD SCREEN MESSAGE	POSSIBLE CAUSE	CORRECTIVE ACTION	DATA-PORT CODE
05	STOPPED PRESSURE OUT OF RANGE PRESS RESET	Distal line pressure outside of range	Position infusion system at patient mid-axillary line	PR1
		Distal line pressure too low	Reprime set	
		Defective administration set	Replace set. If problem recurs, discontinue infusion system use	
		Pressure sensor out of calibration	Replace mechanism assembly *(refer to Section 7.2.18.2* or *Section 7.2.19.2)*	
06	STOPPED AIR IN PROXIMAL LINE PRESS RESET Secondary alarm message: BACKPRIME TO CLEAR AIR INTO SECONDARY YES OR NO?	Air-in-line, proximal sensor	Single channel administration set: reprime using standard techniques. If alarm repeats, replace set	AP1
		Empty container	Replace container and reprime set using standard techniques	
		Cumulative air-in-line volume exceeded due to outgassing or successive air segments introduced by undefiled secondaries	Dual channel administration set: use backpriming techniques or standard repriming techniques	
		Defective administration set or adapter	Replace set if defective and reprime	
		Defective bubble sensor(s)	Replace mechanism assembly *(refer to Section 7.2.18.2 or Section 7.2.19.2)*	

Table 6-1. Alarm Codes and Corrective Actions

ALARM CODE	LCD SCREEN MESSAGE	POSSIBLE CAUSE	CORRECTIVE ACTION	DATA-PORT CODE
07	STOPPED AIR IN DISTAL LINE PRESS RESET Secondary alarm message: IN RESET OPEN DOOR CHECK SET AND RETEST	Air-in-line, distal sensor: excessive air in air trap; incomplete priming; outgassing	Reprime administration set using standard techniques. If alarm repeats, replace set	AD1
		Defective administration set or adapter	Replace set if defective and reprime	
		Defective bubble sensor(s)	Replace mechanism assembly *(refer to Section 7.2.18.2* or *Section 7.2.19.2*	
08 (1.5 series only)	STOPPED AIR IN PROXIMAL LINE PRESS RESET Secondary alarm message: BACK PRIME TO CLEAR AIR INTO SECONDARY YES OR NO? (If yes ↓) CONNECT SECONDARY PRESS & HOLD RESET and ENTER (If no ↓) IN RESET OPEN DOOR AND REPRIME SET	Air detected in administration set air-trap chamber	Single channel administration set: reprime set using standard techniques Dual channel administration set: use backpriming techniques or standard repriming techniques	N/A

Table 6-1. Alarm Codes and Corrective Actions

ALARM CODE	LCD SCREEN MESSAGE	POSSIBLE CAUSE	CORRECTIVE ACTION	DATA-PORT CODE
09 (1.6 series only)	EMPTY CONTAINER PRIMARY KVO #### ML/HR PRESS RESET Secondary alarm message: REFILL/REPLACE PRI CONTAINER PRESS START OR REVIEW/CHANGE	No flow detected: Empty container on primary line	Replace with new container on primary line	FLF
		Occluded primary proximal	Clear alarm	
		Flow detector connected but not attached to the primary drip chamber	Attach flow detector to the primary drip chamber	
		Overfilled drip chamber	Adjust fluid level in drip chamber	
09 (AI EUK 1.6 series only)	EMPTY CONTAINER PRIMARY KVO #### ML/HR PRESS RESET Secondary alarm message: REFILL/REPLACE PRI CONTAINER PRESS START OR REVIEW	No flow detected: Empty container on primary line	Replace with new container on primary line	FLF
		Occluded primary proximal line	Clear alarm	
		Flow detector connected but not attached to the primary drip chamber	Attach flow detector to the primary drip chamber	
		Overfilled drip chamber	Adjust fluid level in drip chamber	
0A (1.6 series only)	CONNECT FLOW DETECTOR OR PRESS RESET TO SET DOSE LIMIT Secondary alarm message: DOSE LIM #### ML PRESS ↑↓ AND ENTER	Flow detector disconnected while infusion system is pumping	Press [RESET] Reconnect flow detector and press [START] or press [RESET] Enter a dose limit Press [START]	FDF

Table 6-1. Alarm Codes and Corrective Actions

ALARM CODE	LCD SCREEN MESSAGE	POSSIBLE CAUSE	CORRECTIVE ACTION	DATA-PORT CODE
0B (1.6 series only)	FLOW DETECTOR CONNECTED PRESS RESET	Flow detector connected while infusion system is pumping	Press [RESET] Reconnect flow detector and press [START] or press [RESET] Enter a dose limit Press [START]	FDT
0C (1.6 series only)	MALFUNCTION CODE 0C	Defective flow detector	Press [RESET] Replace flow detector	MAL
		Defective I/O PWA	If problem repeats with new flow detector, replace I/O PWA	
0D to 10	(Code not used; no alarm)			
11	STOPPED FOR 5 MINUTES PRESS RESET OR REMOVE CASSETTE	Door has been closed for five minutes without further programming Infusion system in RESET longer than five minutes	Press [RESET]. Complete setup and press [START], or open door and remove set	RL
12	DOSE END KVO RATE #### ML/HR PRESS RESET Secondary alarm message: REPEAT PRIMARY RATE #### ML/HR DOSE LIM #### ML YES OR NO?	Dose end	Discontinue delivery or set another primary dose	DE1

Table 6-1. Alarm Codes and Corrective Actions

ALARM CODE	LCD SCREEN MESSAGE	POSSIBLE CAUSE	CORRECTIVE ACTION	DATA-PORT CODE
13	*STOPPED* SYSTEM RETEST REQUIRED PRESS RESET Secondary alarm message: IN RESET OPEN DOOR CHECK SET AND RETEST	Cassette check failed: Occlusion or air in administration set detected at start up	Open all clamps. Prime out excess air. If alarm repeats, replace set. Close door to retest. If alarm repeats, discontinue use	CS1
		Defective administration set	Replace set. Close door to retest	
		Valve pins binding	Clean mechanism front	
		Pressure sensor out of calibration	Replace mechanism assembly *(refer to Section 7.2.18.2* or *Section 7.2.19.2)*	
14	STOPPED SYSTEM RETEST REQUIRED PRESS RESET Secondary alarm message: IN RESET OPEN DOOR CHECK SET AND RETEST	Cassette check failed: Occlusion or air in administration set detected at start up	Open all clamps. Prime out excess air. If alarm repeats, replace set. Close door to retest If alarm repeats, discontinue use	CS1
		Defective administration set	Replace set. Close door to retest	
		Defective mechanism	Replace mechanism assembly *(refer to Section 7.2.18.2* or *Section 7.2.19.2)*	

Table 6-1. Alarm Codes and Corrective Actions

ALARM CODE	LCD SCREEN MESSAGE	POSSIBLE CAUSE	CORRECTIVE ACTION	DATA-PORT CODE
15	STOPPED SYSTEM RETEST REQUIRED PRESS RESET Secondary alarm message: IN RESET OPEN DOOR CHECK SET AND RETEST	Cassette check failed: Occlusion or air in administration set detected at start up	Open all clamps. Prime out excess air. If alarm repeats, replace set. Close door to retest. If alarm repeats, discontinue use	CS1
		Defective administration set	Replace set. Close door to retest	
		Empty primary container	Replace container	
		Defective mechanism; administration set fails backprime check	Replace mechanism assembly *(refer to Section 7.2.18.2* or *Section 7.2.19.2)*	
16 (1.5 series only)	STOPPED CHECK CASSETTE REPRIME SET	Cassette check failed: Occlusion or air in administration set detected at start up	Open all clamps. Prime out excess air. If alarm repeats, replace set. Close door to retest. If alarm repeats, discontinue use	
		Defective administration set	Replace set. Close door to retest	
17	LOW BATTERY PLUG PUMP INTO AC CIRCUIT IMMEDIATELY	Low battery **Note:** LCD message alternates with current operating message	Connect infusion system to AC (mains) power	BLO
17 (AI EUK only)	LOW BATTERY PLUG PUMP INTO MAINS CIRCUIT IMMEDIATELY	Low battery **Note:** LCD message alternates with current operating message	Connect infusion system to AC (mains) power	BLO
18	STOPPED DEAD BATTERY	Battery is fully discharged	Connect infusion system to AC (mains) power Replace battery pack *(refer to Section 7.2.2)*	BLS

Table 6-1. Alarm Codes and Corrective Actions

ALARM CODE	LCD SCREEN MESSAGE	POSSIBLE CAUSE	CORRECTIVE ACTION	DATA-PORT CODE
19	STOPPED DOOR OPENED WHILE PUMPING PRESS RESET	Door opened while infusion system is pumping	Close door. Press [RESET] and [START] to resume	DCO1
1A to 1F	(Code not used; no alarm)			
20	MALFUNCTION CODE 20	Stack runaway error: Defective ROM, RAM, processor, or custom logic	 Replace main PWA *(refer to Section 7.2.17.1)*	MAL20
21	MALFUNCTION CODE 21	Critical data corrupted: Defective RAM Defective VMEM circuit	Replace main PWA *(refer to Section 7.2.17.1)* Replace power supply PWA *(refer to Section 7.2.18.1* or *Section 7.2.19.1)*	MAL21
22 23	MALFUNCTION CODE 22 MALFUNCTION CODE 23	Watchdog frequency too low Watchdog frequency too high Defective CPU or custom logic IC	 Replace main PWA *(refer to Section 7.2.17.1)*	MAL22 MAL23
24 25	MALFUNCTION CODE 24 MALFUNCTION CODE 25	Watchdog detected processor failure Watchdog does not reset processor Defective CPU or custom logic IC	Replace battery (*refer to Section 7.2.2*) Replace main PWA *(refer to Section 7.2.17.1)*	MAL24 MAL25
26	MALFUNCTION CODE 26	Processor internal malfunction: Defective CPU	 Replace main PWA *(refer to Section 7.2.17.1)*	MAL26
27	MALFUNCTION CODE 27	Illegal instruction trap: Defective CPU	 Replace main PWA *(refer to Section 7.2.17.1)*	MAL27

Table 6-1. Alarm Codes and Corrective Actions

ALARM CODE	LCD SCREEN MESSAGE	POSSIBLE CAUSE	CORRECTIVE ACTION	DATA-PORT CODE
28	MALFUNCTION CODE 28	RAM check error: Defective RAM	 Replace main PWA *(refer to Section 7.2.17.1)*	MAL28
29	MALFUNCTION CODE 29	Low ROM checksum error: Defective EPROM	 Replace main PWA *(refer to Section 7.2.17.1)*	MAL29
2A to 2F	(Code not used; no alarm)			
30	MALFUNCTION CODE 30	High ROM checksum error: Defective EPROM	 Replace main PWA *(refer to Section 7.2.17.1)*	MAL30
31	MALFUNCTION CODE 31	Revision numbers do not match: Incorrect EPROM	 Replace main PWA *(refer to Section 7.2.17.1)*	MAL31
32 (1.6 series only)	MALFUNCTION CODE 32	RTC chip failure: Defective RTC chip in U5 socket	 Replace main PWA *(refer to Section 7.2.17.1)*	MAL32
33	MALFUNCTION CODE 33	Serial I/O system failure: Defective I/O PWA	 Replace I/O PWA *(refer to Section 7.2.17.2)*	MAL33
		Defective main PWA	Replace main PWA *(refer to Section 7.2.17.1)*	
34 to 40	(Code not used; no alarm)			

Table 6-1. Alarm Codes and Corrective Actions

ALARM CODE	LCD SCREEN MESSAGE	POSSIBLE CAUSE	CORRECTIVE ACTION	DATA-PORT CODE
41	MALFUNCTION CODE 41	LCD message display read/write failure:		MAL41
		Loose cable P/J11	Check cable connection	
		Defective LCD assembly	Replace LCD assembly *(refer to Section 7.2.16.2)*	
42	MALFUNCTION CODE 42	Message display RAM failure:		MAL42
		Loose cable P/J11	Check cable connection	
		Defective LCD assembly	Replace LCD assembly *(refer to Section 7.2.16.2)*	
43	MALFUNCTION CODE 43	Numeric display digit driver failure:		MAL43
		Loose cable P/J1	Check cable connection	
		Defective LED display PWA	Replace LED display PWA *(refer to Section 7.2.16.1)*	
44	MALFUNCTION CODE 44	Audible alarm failure:		MAL44
		Defective piezoelectric alarm	Replace piezoelectric alarm assembly (*refer to Section 7.2.25)*	
		Defective alarm driver or test circuit	Replace power supply PWA *(refer to Section 7.2.18.1* or *Section 7.2.19.1)*	
45	MALFUNCTION CODE 45	Touchswitch failure:		MAL45
		Touchswitch closed longer than 2 minutes and 40 seconds	Do not close touchswitch longer than specified limit	
		Defective touchswitch panel	Replace touchswitch panel *(refer to Section 7.2.16.3)*	
46 to 5F	(Code not used; no alarm)			

Table 6-1. Alarm Codes and Corrective Actions

ALARM CODE	LCD SCREEN MESSAGE	POSSIBLE CAUSE	CORRECTIVE ACTION	DATA-PORT CODE
60	MALFUNCTION CODE 60	Plunger motor will not home	Lubricate plunger motor shaft (*refer to Section 7.2.29)*	MAL60
		Plunger motor jammed by cassette	Check administration set; replace if defective	
		No power to motor	Replace power supply PWA *(refer to Section 7.2.18.1* or *Section 7.2.19.1)*	
		Defective motor drivers	Replace I/O PWA *(refer to Section 7.2.17.2)*	
		Defective sensor PWA	Replace mechanism assembly *(refer to Section 7.2.18.2* or *Section 7.2.19.2)*	
61	MALFUNCTION CODE 61	I/O valve motor will not home:		MAL61
		Valve motor jammed by cassette	Check administration set; replace if defective	
		No power to motor	Replace power supply PWA *(refer to Section 7.2.18.1* or *Section 7.2.19.1)*	
		Defective motor drivers	Replace I/O PWA *(refer to Section 7.2.17.2)*	
		Defective sensor PWA	Replace mechanism assembly *(refer to Section 7.2.18.2 or Section 7.2.19.2)*	

Table 6-1. Alarm Codes and Corrective Actions

ALARM CODE	LCD SCREEN MESSAGE	POSSIBLE CAUSE	CORRECTIVE ACTION	DATA-PORT CODE
62	MALFUNCTION CODE 62	Primary/secondary valve motor will not home:		MAL62
		Valve motor jammed by cassette	Check administration set; replace if defective	
		No power to motor or faulty 2.5 VDC reference voltage	Replace power supply PWA *(refer to Section 7.2.18.1* or *Section 7.2.19.1)*	
		Defective motor drivers	Replace I/O PWA *(refer to Section 7.2.17.2)*	
		Defective sensor PWA	Replace mechanism assembly *(refer to Section 7.2.18.2* or *Section 7.2.19.2)*	
63	MALFUNCTION CODE 63	Plunger motor slipping or stuck	Lubricate plunger motor shaft (*refer to Section 7.2.29)*	MAL63
		Plunger motor jammed by cassette	Check administration set; replace if defective	
		No power to motor	Replace power supply PWA *(refer to Section 7.2.18.1* or *Section 7.2.19.1)*	
		Defective motor drivers	Replace I/O PWA *(refer to Section 7.2.17.2)*	
		Defective sensor PWA	Replace mechanism assembly *(refer to Section 7.2.18.2* or *Section 7.2.19.2)*	

Table 6-1. Alarm Codes and Corrective Actions

ALARM CODE	LCD SCREEN MESSAGE	POSSIBLE CAUSE	CORRECTIVE ACTION	DATA-PORT CODE
64	MALFUNCTION CODE 64	I/O valve motor slipping or stuck:		MAL64
		Valve motor jammed by cassette	Check administration set; replace if defective	
		No power to motor	Replace power supply PWA *(refer to Section 7.2.18.1* or *Section 7.2.19.1)*	
		Defective motor drivers	Replace I/O PWA *(refer to Section 7.2.17.2)*	
		Defective sensor PWA	Replace mechanism assembly *(refer to Section 7.2.18.2 or Section 7.2.19.2)*	
65	MALFUNCTION CODE 65	Primary/secondary valve motor slipping or stuck:		MAL65
		Valve motor jammed by cassette	Check administration set; replace if defective	
		No power to motor or faulty 2.5 VDC reference voltage	Replace power supply PWA *(refer to Section 7.2.18.1* or *Section 7.2.19.1)*	
		Defective motor drivers	Replace I/O PWA *(refer to Section 7.2.17.2)*	
		Defective sensor PWA	Replace mechanism assembly *(refer to Section 7.2.18.2* or *Section 7.2.19.2)*	
66	MALFUNCTION CODE 66	Motor failure. Internal timers unsynchronized	Note circumstances. Contact Abbott Laboratories	MAL66
67	MALFUNCTION CODE 67	Software motor watchdog confused. Motor not running	Note circumstances. Contact Abbott Laboratories	MAL67
68 to 69	(Code not used; no alarm)			

Table 6-1. Alarm Codes and Corrective Actions

ALARM CODE	LCD SCREEN MESSAGE	POSSIBLE CAUSE	CORRECTIVE ACTION	DATA-PORT CODE
6A	MALFUNCTION CODE 6A	Motor failure. Internal timers unsynchronized	Note circumstances. Contact Abbott Laboratories	MAL6A
6B	CODE 6B			MAL6B
6C	CODE 6C			MAL6C
6D	CODE 6D			MAL6D
6E	CODE 6E			MAL6E
6F to 70	(Code not used; no alarm)			
71	MALFUNCTION CODE 71	Software not executed in 10 ms period	Note circumstances. Contact Abbott Laboratories	MAL71
72	MALFUNCTION CODE 72	Defective pressure sensor or A/D converter	Replace mechanism *(refer to Section 7.2.18.2* or *Section 7.2.19.2*) or main PWA *(refer to Section 7.2.17.1)*	MAL72
73	MALFUNCTION CODE 73	A/D converter failure (0, 2.5 and 5 V tests):		MAL73
		Defective A/D converter IC	Replace main PWA *(refer to Section 7.2.17.1)*	
		Defective custom logic IC	Replace I/O PWA *(refer to Section 7.2.17.2)*	
74	MALFUNCTION CODE 74	Ultrasound transmitter or receiver failure:		MAL74
		Defective sensor or bubble PWA	Replace mechanism assembly *(refer to Section 7.2.18.2* or *Section 7.2.19.2*)	

Table 6-1. Alarm Codes and Corrective Actions

ALARM CODE	LCD SCREEN MESSAGE	POSSIBLE CAUSE	CORRECTIVE ACTION	DATA-PORT CODE
75	MALFUNCTION CODE 75	Overvoltage protection failure:		MAL75
		Defective overvoltage protection circuitry	Replace power supply PWA *(refer to Section 7.2.18.1* or *Section 7.2.19.1)*	
		Defective custom logic IC	Replace I/O PWA *(refer to Section 7.2.17.2)*	
76	MALFUNCTION CODE 76	Distal air sensor failed on-going check:		MAL76
		Defective bubble sensor or sensor PWA	Replace mechanism assembly *(refer to Section 7.2.18.2* or *Section 7.2.19.2)*	
77	MALFUNCTION CODE 77	Proximal air sensor failed on-going check:		MAL77
		Defective custom logic IC	Replace I/O PWA *(refer to Section 7.2.17.2)*	
78	MALFUNCTION CODE 78	Proximal air sensor is off when it should be on	Replace I/O PWA *(refer to Section 7.2.17.2)* or mechanism assembly *(refer to Section 7.2.18.2* or *Section 7.2.19.2)*	MAL78
79	MALFUNCTION CODE 79	Primary/secondary valve safety spring broken:		MAL79
		Defective mechanism assembly	Replace mechanism assembly *(refer to Section 7.2.18.2* or *Section 7.2.19.2)*	
7A	MALFUNCTION CODE 7A	Proximal pressure sensor failed	Replace mechanism assembly *(refer to Section 7.2.18.2 or Section 7.2.19.2)*	MAL7A

Table 6-1. Alarm Codes and Corrective Actions

ALARM CODE	LCD SCREEN MESSAGE	POSSIBLE CAUSE	CORRECTIVE ACTION	DATA-PORT CODE
7B	MALFUNCTION CODE 7B	Software motor watchdog is confused. Motor not running	Note circumstances. Contact Abbott Laboratories	MAL7B
7C	CODE 7C			MAL7C
7D	CODE 7D			MAL7D
7E	CODE 7E			MAL7E
7F	CODE 7F			MAL7F
80 to 89	(Code not used; no alarm)			
8A	MALFUNCTION CODE 8A	Software motor watchdog is confused. Motor not running	Note circumstances. Contact Abbott Laboratories	MAL8A
8B to 90	(Code not used; no alarm)			
91 (1.6 series only)	MALFUNCTION CODE 91	Overflow compensation table in PRI_OR_SEC_NXT	Note circumstances. Contact Abbott Laboratories	MAL91
92	MALFUNCTION CODE 92	RATEMATH calculation error from table overflow	Note circumstances. Contact Abbott Laboratories	MAL92
93	MALFUNCTION CODE 93	No synchronization, failed flag set after failing synchronization	Note circumstances. Contact Abbott Laboratories	MAL93
94 to 96	(Code not used; no alarm)			
97	MALFUNCTION CODE 97	Rate checking failure within RATSEL routine	Note circumstances. Contact Abbott Laboratories	MAL97
98	MALFUNCTION CODE 98	Rate equals zero or division by zero	Note circumstances. Contact Abbott Laboratories	MAL98
99	MALFUNCTION CODE 99	Division by zero (used by S_DIV.)	Note circumstances. Contact Abbott Laboratories	MAL99
9A (1.6 series only)	MALFUNCTION CODE 9A	New alarm without setting alarm bit in ALMBRD	Note circumstances. Contact Abbott Laboratories	MAL9A
9B (1.6 series only)	MALFUNCTION CODE 9B	OCR timer interrupt error trap at IHANDR routine. Defective CPU	Replace main PWA *(refer to Section 7.2.17.1)*	MAL9B

Table 6-1. Alarm Codes and Corrective Actions

ALARM CODE	LCD SCREEN MESSAGE	POSSIBLE CAUSE	CORRECTIVE ACTION	DATA-PORT CODE
9C to A1	(Code not used; no alarm)			
A2	MALFUNCTION CODE A2	Motor power up not detected	Replace power supply PWA *(refer to Section 7.2.18.1 or Section 7.2.19.1)*	MALA2
A3	MALFUNCTION CODE A3	Motor power down not detected	Replace power supply PWA *(refer to Section 7.2.18.1* or *Section 7.2.19.1)*	MALA3
A4	MALFUNCTION CODE A4	Illegal BCD digit in DRATE	Note circumstances. Contact Abbott Laboratories	MALA4
A5	MALFUNCTION CODE A5	Executive code in infinite loop	Note circumstances. Contact Abbott Laboratories	MALA5
A6	MALFUNCTION CODE A6	Unknown failure type, motor related	Note circumstances. Contact Abbott Laboratories	MALA6
A7	MALFUNCTION CODE A7	Potential PURGE runaway hazard detected	Note circumstances. Contact Abbott Laboratories	MALA7
A8 to FF	(Code not used; no alarm)			

6.2.2
OBTAINING AN ALARM HISTORY (1.5 SERIES)

A rolling history of alarm codes may be obtained by accessing the alarm history data screen. The alarm history screen appears on the LCD when the [REVIEW/CHANGE] touchswitch is pressed twice during the first three-to-five second interval after the door is closed and the SELF TEST:OK screen is displayed. The alarm history data screen displays 15 alarm codes, with the most recent code appearing at the lower right hand corner of the screen. Alarm code history data will be retained in memory unless both sources of primary power (AC (mains) and battery pack) are lost.

6.2.3
OBTAINING AN ALARM HISTORY (1.6 SERIES)

A rolling history of alarm codes may be obtained by accessing the alarm history data screen. The alarm history screen appears on the LCD when the [REVIEW/CHANGE] touchswitch is pressed twice during the first three-to-five second interval after the door is closed and the SELF TEST:OK screen is displayed. The alarm history data screen displays 15 alarm codes, with the most recent code appearing at the lower right hand corner of the screen.

6.3
ALARM AND MALFUNCTION CODES

Alarm and malfunction codes are listed in *Table 6-1, Alarm Codes and Corrective Actions.* For malfunction codes requiring corrective action beyond the scope of this manual, contact Abbott Laboratories.

6.3.1
ALARM CODES

Alarm codes 01 through 19 may typically be corrected by the system operator. Refer to *Table 6-1, Alarm Codes and Corrective Actions,* for a definition and appropriate corrective action for each of these codes.

6.3.2
MICROPROCESSOR OR SYSTEM ALARM CODES

Alarm codes are 20 through 33 are microprocessor or system alarm codes. Refer to *Table 6-1, Alarm Codes and Corrective Actions,* for a definition and appropriate corrective action for each of these codes.

6.3.3
DISPLAY, AUDIBLE, AND TOUCHSWITCH ALARM CODES

Alarm codes 41 through 45 are display, audible, and touchswitch alarm codes. Refer to *Table 6-1, Alarm Codes and Corrective Actions,* for a definition and appropriate corrective action for each of these codes.

6.3.4
INFUSION PUMPING MECHANISM ALARM CODES

Alarm codes 60 through 67 are infusion pumping mechanism alarm codes. Refer to *Table 6-1, Alarm Codes and Corrective Actions,* for a definition and appropriate corrective action for each of these codes.

6.3.5
MISCELLANEOUS ALARM CODES

Alarm codes 6A through A7 are miscellaneous alarm codes. Refer to *Table 6-1, Alarm Codes and Corrective Actions,* for a definition and appropriate corrective action for each of these codes.

6.4
INFUSION SYSTEM TROUBLESHOOTING

Before troubleshooting an alarm, open and close the infusion system door and allow the self test to complete. If an alarm persists, carefully inspect the infusion system for signs of damage as described in *Section 5.1.1, Inspecting the Infusion System,* and perform the corrective action specified in *Table 6-1, Alarm Codes and Corrective Actions,* or *Table 6-2, Troubleshooting DataPort Systems (1.6 DataPort Only).*

Failures listed in *Table 6-2* that do not cause an alarm are detected by observation only when using the DataPort communications feature.

Note: Some corrective actions listed in *Table 6-1* and *Table 6-2* are beyond the scope of this manual. In such instances, contact Abbott Laboratories.

Table 6-2. Troubleshooting DataPort Systems (1.6 DataPort Only)

CODE OR SYMPTOM	POSSIBLE CAUSE	CORRECTIVE ACTION
Infusion system does not reply to packet sent by host computer	Infusion system not connected to cable or DataPort bus	Check all cable and junction box connections
	Host computer defective	Run DataPort communication program in *Section 5.3.12.* If program passes, refer to *LifeCare 5000 Concurrent Flow Infusion System with DataPort Programmer's Guide* to check software
	Infusion system is turned off or is malfunctioning	Turn infusion system on. Run DataPort communication program in *Section 5.3.12*; if infusion system fails test, contact Abbott Laboratories
	Defective junction box	Bypass junction box and connect host computer directly to infusion system. If problem is corrected, replace junction box; if problem is not corrected, replace I/O PWA *(refer to Section 7.2.17.2)*
	Infusion system with incorrect software revision connected to DataPort bus	Check infusion system software revision *(refer to Section 1.7)*

Table 6-2. Troubleshooting DataPort Systems (1.6 DataPort Only)

CODE OR SYMPTOM	POSSIBLE CAUSE	CORRECTIVE ACTION
Packets are received incorrectly by the infusion system or host computer	Junction box DIP switches not set correctly	Check DIP switch setting for hard ID
	Host computer defective	Run DataPort communication program in *Section 5.3.12.* If program passes, refer to *LifeCare 5000 Concurrent Flow Infusion System with DataPort Programmer's Guide* to check software
	Cable disconnected while transmission in progress	Check condition of connector and replace if necessary
	Electromagnetic interference from adjacent equipment	Remove or repair source of interference. If problem persists, contact Abbott Laboratories
	Bus traffic resulting from connection to a non-LifeCare 5000 1.6 Series infusion system with DataPort	Disconnect nonconforming equipment
	Bus wire length or electrical signals do not meet EIA-232D standards. Leads can be open or shorted	Use port that conforms to EIA-232D standard and DataPort cables
Host computer receives garbled responses to messages sent to infusion system	Host computer defective	Run DataPort communication program in *Section 5.3.12.* If program passes, refer to *LifeCare 5000 Concurrent Flow Infusion System with DataPort Programmer's Guide* to check software
Host computer detects infusion systems that are not present	Defective junction box	Bypass junction box and connect host computer directly to infusion system. If problem is corrected, replace junction box; if problem is not corrected, replace I/O PWA (*refer Section 7.2.17.2)*

6.5
TROUBLESHOOTING WITH THE PVT

Table 6-3, Troubleshooting with the PVT (1.5 Series), and *Table 6-4, Troubleshooting with the PVT (1.6 Series)*, lists failures that may be detected during the PVT. If an error code displays, see *Section 6.2.1, Alarm Messages*.

Table 6-3. Troubleshooting with the PVT (1.5 Series)

Test Failures	Possible Causes	Corrective Actions
Start-up test *Section 5.2.3*	Cassette not properly installed	Re-prime and re-insert cassette
	Faulty cassette	Replace administration set
	Defective power supply PWA	Replace power supply PWA
	Defective touchswitch panel	Replace touchswitch panel
Bubble sensor location test *Section 5.2.4*	Bubble sensor location fixture not calibrated	Calibrate bubble sensor location fixture calibration block
	Calibration block not calibrated to required specifications	Verify valid calibration date
Nurse-call test *Section 5.2.5*	Defective nurse call cable	Replace nurse call cable
	Defective I/O PWA	Replace I/O PWA
Empty container test *Section 5.2.6*	Defective special cassette	Replace special cassette
	Dirty bubble sensors	Clean bubble sensors
	Defective bubble sensor PWA	Replace mechanism assembly
	Proximal bubble sensor tips removed incorrectly	Re-cut proximal bubble sensor tips
	Distal bubble sensor tips removed incorrectly	Re-cut distal bubble sensor tips
Air-in-line test *Section 5.2.7*	Defective special cassette	Replace special cassette
	Dirty bubble sensor	Clean bubble sensors
	Defective bubble sensor PWA	Replace mechanism assembly

Table 6-3. Troubleshooting with the PVT (1.5 Series)		
Battery charger test *Section 5.2.8*	Blown fuse Defective AC (mains) cordset Defective power supply PWA	Replace Fuse Replace AC (mains) cordset Replace power supply PWA
Concurrent delivery test *Section 5.2.9*	Damaged or faulty administration set Defective mechanism assembly	Replace administration set and re-prime cassette Replace mechanism assembly
Delivery accuracy test *Section 5.2.10*	Cassette not properly primed Damaged or faulty administration set Defective mechanism assembly	Re-prime cassette Replace administration set and re-prime cassette Replace mechanism assembly
Pressure sensor test *Section 5.2.11*	Cassette not properly primed Defective cassette Dirty sensor pin Defective sensor PWA	Re-prime cassette Replace cassette Clean sensor pin Replace mechanism assembly
Electrical safety test *Section 5.2.12*	Insufficient ground connection Defective AC (mains) cordset Defective power supply PWA	Check electrical safety analyzer return line Replace AC (mains) cordset Replace power supply PWA

Table 6-4. Troubleshooting with the PVT (1.6 Series)

Test Failures	Possible Causes	Corrective Actions
Start-up test *Section 5.3.3*	Cassette not properly installed	Re-prime and re-insert cassette
	Faulty cassette	Replace administration set
	Defective power supply PWA	Replace power supply PWA
	Defective touchswitch panel	Replace touchswitch panel
Bubble sensor location test *Section 5.3.4*	Bubble sensor location fixture not calibrated	Calibrate bubble sensor location fixture calibration block
	Calibration block not calibrated to required specifications	Verify valid calibration date
Nurse-call test *Section 5.3.5*	Defective nurse call cable	Replace nurse call cable
	Defective I/O PWA	Replace I/O PWA
Empty container test *Section 5.3.6*	Defective special cassette	Replace special cassette
	Dirty bubble sensors	Clean bubble sensors
	Defective bubble sensor PWA	Replace mechanism assembly
	Proximal bubble sensor tips removed incorrectly	Re-cut proximal bubble sensor tips
	Distal bubble sensor tips removed incorrectly	Re-cut distal bubble sensor tips
Air-in-line test *Section 5.3.7*	Defective special cassette	Replace special cassette
	Dirty bubble sensor	Clean bubble sensors
	Defective bubble sensor PWA	Replace mechanism assembly
Battery charger test *Section 5.3.8*	Blown fuse	Replace fuse
	Defective AC (mains) cordset	Replace AC (mains) cordset
	Defective power supply PWA	Replace power supply PWA

Table 6-4. Troubleshooting with the PVT (1.6 Series)		
Delivery accuracy test *Section 5.3.9*	Cassette not properly primed	Re-prime cassette
	Damaged or faulty administration set	Replace administration set and re-prime cassette
	Defective mechanism assembly	Replace mechanism assembly
Pressure sensor test *Section 5.3.10*	Cassette not properly primed	Re-prime cassette
	Defective cassette	Replace cassette
	Dirty sensor pin	Clean sensor pin
	Defective sensor PWA	Replace mechanism assembly
Electrical safety test *Section 5.3.11*	Insufficient ground connection	Check electrical safety analyzer return line
	Defective AC (mains) cordset	Replace AC (mains) cordset
	Defective power supply PWA	Replace power supply PWA
DataPort communication test *Section 5.3.12*	Damaged or faulty DataPort accessory cable	Replace DataPort accessory cable
	Test program written incorrectly	Verify correct program entry
	Defective I/O PWA	Replace I/O PWA

Section 7

REPLACEABLE PARTS AND REPAIRS

This section itemizes all parts and subassemblies of the infusion system that are repairable within the scope of this manual. In addition, this section describes replacement procedures for all listed parts.

WARNING:

POSSIBLE EXPLOSION HAZARD IF SERVICED OR REPAIRED IN THE PRESENCE OF FLAMMABLE ANESTHETICS.

7.1 REPLACEABLE PARTS LIST

Replaceable parts for the infusion system are itemized in the spare parts price list and are identified in *Figure 9-1, IPB for the Infusion System. Table 9-2, IPB for the Infusion System,* identifies each infusion system part by an index number that correlates to *Figure 9-1.* To request a copy of the current spare parts price list, contact Abbott Laboratories (*see Section 6.1, Technical Assistance*). For convenient reference, insert a copy of the spare parts price list here.

Note: Certain part numbers are specific to 1.5 series infusion systems or 1.6 series infusion systems. Certain part numbers apply to all infusion systems.

This page intentionally left blank.